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SUBJECT: The Corrosion Resistance of 86% Fe-5% Si-5% Cu- 4% B
Brazing Alloy to High-Temperature Lithium

TO: W. D. Manly

FROM: D. H. Jansen

Distribution:

1. W. D. Manly
2. P. R. Bell, Jr.
3. R. E. Clausing
4. J. H. DeVan
5. E. E. Hoffman
6. D. H. Jansen
7. P. Patriarca
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Summary:

The 86% Fe-5% Si-5% Cu-4% B brazing alloys shows better corrosion resistance to high-temperature lithium than any of the nickel-base brazing materials tested to date. A preferential leaching of the surface of the alloy to a depth of two to three mils was observed on the alloy specimens tested in lithium at 1500° F. A greater weight loss, associated with subsurface voids, was found on specimens tested under dynamic conditions than was observed on the alloy when statically tested at the same temperature. This greater severity of attack in the presence of dynamic lithium has been observed in other lithium-corrosion systems.

Introduction:

As iron-base brazing alloys become available, they are subjected to screening corrosion tests in lithium, since high-nickel-content brazing alloys have shown inferior resistance to this bath in the 1500° F temperature range. Consequently, a 86% Fe-5% Si-5% Cu-4% B alloy (a Coast Metals experimental heat) was studied in both static and seesaw corrosion tests. Two drawbacks of this material are its high-brazing temperature (2150° F) and the porosity that appears in the body of the brazing alloy.

Procedure:

The alloy specimens used were type 316 stainless steel tube-to-header joints brazed with the 86% Fe-5% Si-5% Cu-4% B alloy. Capsules, also type 316 stainless steel, were loaded and filled to one-third their volumes under an inert-argon atmosphere, then sealed by heliarc welding.

Two 100-hr duration tests were conducted: one seesaw test with a hot-zone temperature maintained at 1500° F; the other, a static test at 1500° F.

Upon completion of the tests, the lithium bath was analyzed for copper content and the test specimens checked metallagraphically for attack and condition.

The type of specimens used for testing purposes is shown in Fig. 1 (Y-17346).

Results:

The surface of the specimens from the static test was found to be depleted in the second phase to a depth of two to three mils as shown in Figs. 2 (Y-23818) and 3 (Y-23819). The same type of depleted region was observed on the specimens subjected to the seesaw tests, Fig. 4 (Y-23820), but with an accompanying subsurface void formation to a depth of ten mils in one area. Weight loss on the seesaw test specimens was 0.13%, about five times the weight loss found on the

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specimens undergoing the static test.

Copper concentration of the lithium baths from each test was approximately the same, 0.06%.

Fig. 1 (Y-17346) Configuration of Tube-to-Header Joint Used for Corrosion Tests on Brazing Alloys.

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Fig. 2 (Y-23818) The 86% Fe-5% Si-5% Cu-4% B Brazing Alloy After 100-Hr Static Test in Lithium at 1500°F. Etchant - None.

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Fig. 3 (Y-23819) Same as Fig. 2 but at a Higher Magnification Showing Detail at the Leached Edge. Etchant - None.

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Fig. 4 (Y-23820) 86% Fe-5% Si-5% Cu-4% B Brazing Alloy on Type 316 Stainless Steel Tube-to-Header Joint After Exposure to Lithium in a 100-Hr Seesaw Test at 1500°F Hot-Zone Temperature. Etchant - As Polished.

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